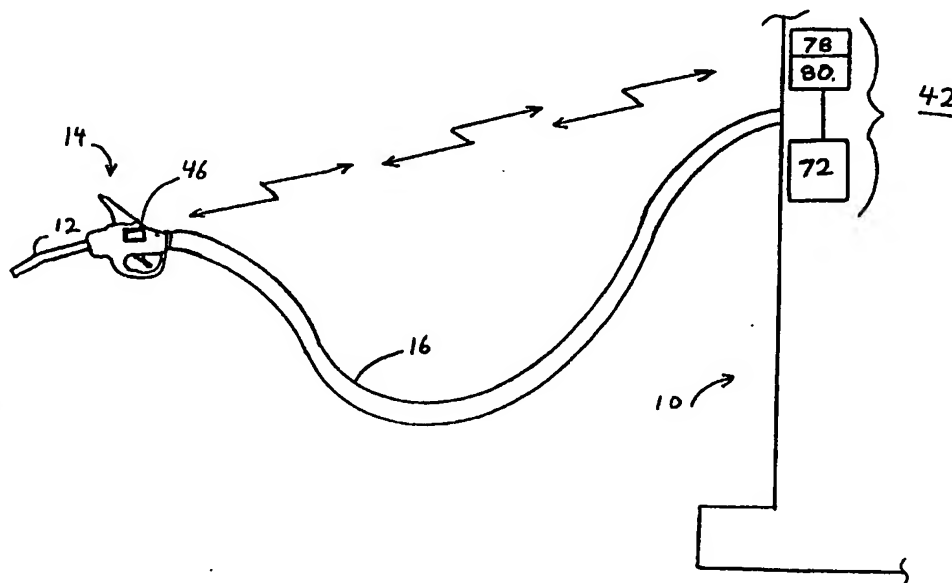




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>B67D 5/14</b>	<b>A1</b>	(11) International Publication Number: <b>WO 99/44936</b> (43) International Publication Date: 10 September 1999 (10.09.99)
(21) International Application Number: PCT/GB99/00661 (22) International Filing Date: 5 March 1999 (05.03.99)  (30) Priority Data: 09/036,112          6 March 1998 (06.03.98)          US  (71) Applicant: GILBARCO LIMITED [GB/GB]; Crompton Close, Basildon, Essex SS14 3BA (GB). (72) Inventor: LEATHERMAN, Russel, Dean; 6106 Four Oaks Court, Summerfield, NC 27358 (US). (74) Agent: COCKAYNE, Gillian; GEC Patent Dept., Waterhouse Lane, Chelmsford, Essex CM1 2QX (GB).	(81) Designated States: AU, BR, NZ, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>	

(54) Title: NOZZLE FOR A FUEL DISPENSING SYSTEM



## (57) Abstract

The present invention provides a nozzle (14) having a communication system capable of wireless, remote communications with an associated fuel dispensing system, such as a fuel dispenser (10). Information may be transmitted from the dispenser to the nozzle to facilitate nozzle control or display to a customer, and information received at the nozzle may be transmitted to the dispenser for further processing or display.

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**NOZZLE FOR A FUEL DISPENSING SYSTEM**

The present invention relates to a nozzle for a fuel dispensing system.

Historically, designers of fuel dispensers and nozzles have attempted to provide electronics, displays, and basic controller functions within the nozzle itself. These attempts have been unacceptable given the difficulty of transporting electrical power and signals from the fuel dispenser to the nozzle in a safe manner. U.S. Patent No. 4,005,412, issued on June 25, 1977 to Leandr is exemplary of the prior art. Leandr discloses a display placed on a fuel dispenser's nozzle. The display is capable of displaying the amount of fuel dispensed, or other desired information. The nozzle is completely powered by a battery installed therein. Another example of such a nozzle is described in U.S. Patent No. 4,140,013 to Hunger. The Hunger reference discloses a nozzle having an electronic flow meter and a display system for displaying data to a customer. The reference suggests using a battery for powering the electronic flow meter and display.

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Numerous other attempts have been made in the prior art to provide electronics and computer-type capabilities at the dispensing nozzle. The problem in the prior art is that no safe and energy efficient way exists to provide power and communications to the nozzle. Because of the high volatility of fuel being dispensed, it has always been unsafe to provide direct power supplies in the nozzle, or to run electrical wires to the nozzle. As a result, although numerous patents and prior art publications showing electronics

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installed in fuel dispensing nozzles exist, none of these have met with commercial success. Regulatory bodies responsible for safety, such as Underwriters Laboratories (UL), have been reluctant to grant approval to fuel dispensing nozzles with unsafe power supplies built in.

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Another problem with powering and communicating with fuel dispensing nozzles is that wires must run from the remote location, down the fuel dispensing hose, to the nozzle. The problem with this is that the nozzle is often twisted and turned by the user relative to the fuel dispensing hose. Such use presents the danger that the wires will bend too often and eventually fray or electrically short to one another. Due to the volatility of the fuel being dispensed, the situation can become dangerous and explosions may occur.

U.S. Patent Nos. 5,184,309 and 5,365,984 to Simpson *et al.* disclose an intelligent dispensing nozzle and an electrical connector and fuel dispenser hose for providing an electronic connection between the dispenser and the intelligent nozzle, respectively. The first Simpson *et al.* reference discloses a rechargeable battery and one of two power supply means. The first power supply means facilitates an electromagnetic coupling of the nozzle to the fuel dispenser, when the nozzle is placed in the dispenser. With the electromagnetic coupling, the fuel dispenser is unable to communicate with the nozzle during a fuelling operation. All information must be gathered and sent to the dispenser after the fuelling operation is ended and the nozzle is placed back on the dispenser.

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The second embodiment uses an electrical-to-optical power conversion and requires an

expensive, complex fuel delivery hose having an optical link between the dispenser and nozzle. The electrical-to-optical conversion provides limited power and requires complex mechanical configurations to maintain connection between the nozzle and delivery hose and the dispenser and delivery hose, especially since the nozzle is preferably designed to  
5 twist relative to the delivery hose.

The second Simpson *et al.* reference discloses a connector for an electrical connection between the dispenser nozzle and the delivery hose. The electrical connector and dispensing hose disclosed are very complex and expensive to manufacture, in addition to  
10 being incompatible with all nozzles other than a specific nozzle design to interface with such hose and connector. Both of the Simpson *et al.* patents are incorporated herein by reference.

Given the desire to provide user-friendly electronics, data input capabilities and other  
15 components, which require electric power, in a fuel dispensing nozzle, it can be appreciated from the above discussion that there is a need to provide a safe, efficient and easy-to-manufacture technique for providing communications between a fuel dispenser and the dispensing nozzle.

20 The present invention provides a nozzle for a fuel dispensing system characterised in comprising a control system and wireless communication electronics operatively associated with said control system and adapted to provide wireless communications between said nozzle and a dispensing system communication device, by which term is

meant a communication device associated with the dispensing system.

Information may be transmitted from the dispensing system to the nozzle to facilitate nozzle control or display to a customer, and information received at the nozzle may be  
5 transmitted to the dispensing system for further processing or display.

The nozzle may include a power supply with or without a battery, recharging circuitry and optional energy coupling electronics to aid in recharging the battery. Energy may be electromagnetically coupled to the nozzle from a transformer. Preferably, such  
10 recharging using the electromagnetically-coupled energy occurs when the nozzle is mounted in a dispenser.

Employing the present invention may alleviate the need for a traditional fuel dispenser, as all features necessary for the performance of a fuelling transaction may be incorporated  
15 on the nozzle. For example, the nozzle may include a display coupled to the control system to display information to a customer. An input device may be provided and coupled to the control system to allow a customer to input information to the control system. The input device may be a keypad and/or card reader.

20 The nozzle trigger may be operatively coupled to a trigger position detector adapted to provide a trigger position signal indicative of trigger position. The control system will receive the trigger position signal and provide a flow control signal based thereon. The flow signal may be used to derive a flow control signal configured to operate a flow

control valve. Optionally, the flow control signal and any other information may be transmitted to the fuel dispensing system for additional flow control. Thus, information gathered at the nozzle or received by the customer at the nozzle may be used at the nozzle and/or transmitted to the fuel dispensing system for processing. Information gathered or  
5 received at the fuel dispensing system may be transmitted to the nozzle for processing at the nozzle or displayed to the customer at the nozzle.

Additionally, the nozzle may include various sensors, such as octane sensors in the fuel delivery path or hydrocarbon concentration sensors in the vapour recovery path to  
10 provide signals to control fuel delivery and vapour recovery, respectively. The control may take place at the nozzle and/or the dispensing system after transmission.

Communications are preferably radio communications in the microwave range, but may include radio communications or any other type of wireless communication means to  
15 facilitate information transfer. Preferably, the information is transmitted through free air between the dispensing system and nozzle, but may be transmitted wirelessly within the fuel delivery hose wherein the hose acts as a wave guide channelling signals back and forth between the nozzle and a fuel dispenser.

20 Another aspect of the present invention provides a fuel dispensing system for communicating with a nozzle. The dispensing system includes communications electronics and a control system. A nozzle control system is used to process information at the nozzle and is associated with wireless dispensing system communication electronics

operatively associated with the control system and adapted to provide wireless communications between the nozzle and the dispensing system communications electronics. The control system and communications electronics of the nozzle operate to provide an intrinsically safe wireless communication link between the nozzle  
5 communications electronics and the dispensing system communications electronics.

These and other aspects of the present invention will become apparent to those skilled in the art after reading the following description of the preferred embodiments when considered with the drawings, in which:-

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Figure 1 is a schematic sectional view of a typical fuel dispensing system, in the form of a fuel dispenser, constructed according to the present invention;

Figure 2 is a front view of the fuel dispenser of Figure 1;

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Figure 3 is a schematic representation of the dispensing system communication and control system electronics according to the present invention;

Figure 4A is a schematic representation of the nozzle control and communication  
20 electronics according to the present invention;

Figure 4B is a schematic representation of an alternative embodiment of the nozzle control and communications electronics constructed according to the present invention;

Figure 5 is a cross-sectional schematic representation of a fuel dispensing nozzle constructed according to the present invention;

Figure 6 is a schematic representation of the top of a fuel dispensing nozzle of Figure 5;

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Figure 7 is a schematic representation of a nozzle and dispensing system providing for free-air communications therebetween constructed according to the present invention;

Figure 8 is a schematic representation of a fuel dispensing nozzle and a fuel dispenser  
10 providing for wireless communications using the delivery hose as a wave guide constructed according to the present invention; and

Figure 9 is a flow chart representing the basic flow of the interaction of a dispensing nozzle with a fuel dispensing system according to an embodiment of the present  
15 invention.

Referring now to the drawings in general, and Figure 1 in particular, it will be understood that the illustrations are for the purpose of describing a preferred embodiment of the invention and are not intended to limit the invention thereto. As best seen in  
20 Figure 1, in a typical service station, a vehicle 1 is shown being fuelled from a fuel dispenser 10. A spout 12 of nozzle 14 is shown inserted into a filler pipe 2 of a fuel tank 4 during the refuelling of the vehicle 1.

A fuel delivery hose 16 having vapour recovery capability is connected at one end to the nozzle 14, and at its other end to the fuel dispenser 10. As shown by the enlarged cutaway view of the interior of the fuel delivery hose 16, an annular fuel delivery passageway 20 is formed within the fuel delivery hose 16 for distributing fuel pumped  
5 from an underground storage tank 22 to the nozzle 14. Also within the fuel delivery hose 16 is a tubular vapour recovery passageway 24 for transferring fuel vapours expelled from the vehicle's fuel tank 4 to the underground storage tank 22 during the fuelling of a vehicle. The fuel delivery hose 16 is depicted as having an internal vapour recovery hose 26 for creating the vapour recovery passage from the spout 12 to the underground  
10 storage tank 22. Inside the dispenser 10, fuel is carried to hose 16 by piping 30, and vapour is returned through recovery hose 32.

A vapour recovery pump 34 provides a vacuum in the vapour recovery passage for removing fuel vapour during a refuelling operation. The vapour recovery pump 34 may  
15 be placed anywhere along the vapour recovery passage between the nozzle 12 and the underground fuel storage tank 22. The vapour recovery system using the pump 14 may be any suitable system, such as those shown in U.S. Patent Nos. 5,040,577 to Pope, 5,195,564 to Spalding, 5,333,655 to Bergamini *et al.*, or 3,016,928 to Brandt. Various ones of these systems are now in commercial use recovering vapour during refuelling of  
20 conventional non-ORVR (Onboard Refuelling Vapour Recovery) vehicles. The present invention addresses an adaptation of those systems for use with ORVR vehicles.

The dispenser 10 also includes a fuel delivery pump 36 for effecting delivery of fuel to

the vehicle, a flow meter 38 providing volumetric measures of fuel delivery, and a control valve 40 for selectively and preferably variably controlling fuel flow. The control valve 40 is preferably an electronically controlled flow valve adapted to continuously vary flow rate. A dispenser control and communications system 42 having antennas 44  
5 is adapted to provide control of the fuel dispenser and communications to a nozzle control and communications system 46 located within the nozzle 14.

Turning now to Figure 2, the front schematic view of the dispenser shows the dispenser control electronics 48, communications electronics 50, associated memory 52, control  
10 lines 54 and various dispenser components in addition to those shown in Figure 1. These components include one or more dispenser displays 56 for providing anything from transactional information to advertising and other information. Dispenser keypads 58 are provided to receive customer information and inputs wherein the keypads 58 and displays 56 may provide a multimedia customer interface. The dispenser may also include a card  
15 reader 60 for receiving payment from credit, debit, smart and other transactional-type cards, as well as a cash acceptor 62 for receiving currency. A printer is provided to give the customer a hard copy of a receipt for the fuel and any other products ordered and/or paid for using the dispenser's customer interface. To complete the multimedia functionality of the dispenser, an audio system 66 is provided having a microphone and  
20 speaker for providing various types of audio information and entertainment, and receive audible requests, instructions or information from the customer.

Figure 3 provides a block diagram of the dispenser control and communications system,

and some of the dispenser components with which the system interacts. The system will include a power supply 70, control electronics 48, and communications electronics 50 associated with or including memory 74 and the requisite software 76 to operate the system. The communications electronics 50 will include or be associated with a receiver  
5 78 and transmitter 80 having one or more antennas to provide for radio communications to the nozzle control and communications system 46. The communications system may include switching circuitry and/or circulator circuitry to provide for transmission and reception from a single antenna or set of antennas.

10 The power supply 70 may also be associated with an energy coupling system 82 adapted to provide remote power to the nozzle, if necessary, in order to power the electronics or recharge batteries. The coupling may be a direct electrical connection or an electromagnetic or optical connection as disclosed in U.S. Patent Nos. 5,184,308 and 5,365,984, both to Simpson *et al.*, the disclosures of which have been incorporated  
15 herein by reference.

As shown in Figure 3, the control system includes an input/output (I/O) port 86 for providing and receiving information, including both data and control information. The dispenser control system 42 may receive volumetric flow information from a flow meter  
20 38, control the flow valves 40, and operate the delivery pump 36 as desired to start, stop and variably control the delivery of fuel from the underground storage tank 22 to the vehicle's tank 4. The control system may also operate to control the vapour recovery pump 34 or other vapour recovery components to recover vapours escaping the vehicle's

fuel tank 4 during the fuelling operation. Attention is drawn to U.S. Patent 5,782,275 entitled ONBOARD VAPOUR RECOVERY DETECTION and WO 97/21626 entitled INTELLIGENT FUELLING.

- 5 The dispenser control system 42 may also communicate with a site controller located apart from the fuel dispenser, and preferably in a fuel station store to provide overall, centralized control of the fuel station environment and the dispensers therein. A central-site controller 84, such as the G-Site controller sold by Gilbarco Inc., 7300 West Friendly Avenue, Greensboro, North Carolina, may also communicate with a remote
- 10 network, such as a card verification authority, to ascertain whether a transaction to be charged to or debited from an account associated with the card inserted in the card reader 60 is authorized. The control system may also cooperate with the display 56 and keypad 58 to provide the graphical user interface discussed above as well as accept payment or payment information from the card reader 60 or cash acceptor 62. The dispenser control
- 15 and communications system 42 is preferably comparable to the microprocessor-based control systems used in CRIND (card reader in dispenser) and TRIND (tag or transponder reader in dispenser) type units sold by Gilbarco Inc. under the trademark THE ADVANTAGE.
- 20 The communications and control electronics may be separate or integrated and are preferably configured as a control system associated with an interrogator providing the control electronics and the ability to communicate with the nozzle communications and control system 46. Any type of radio communications, uni-directional or bi-directional,

depending on the configuration, is considered within the scope of the invention and the claims that follow this disclosure.

With reference to Figure 4A, a basic nozzle control and communications system 46 is  
5 shown. Like the dispenser's communications control system, the nozzle control and communications system will include a power supply 90, preferably including a battery and any necessary recharging circuitry, if desired. A controller 93 and communications electronics 92 cooperate in association with a memory 94 and any requisite software 96 to make the system operational. The communications electronics 92 include or are  
10 associated with a receiver 98 and transmitter 100, which are coupled to one or more antennas 99. Again, various antenna and communication circuitry may be employed to use one or more antennas to provide separate or integrated transmission and reception.

The nozzle communications and control system also includes an energy coupling  
15 mechanism 102 adapted to cooperate with the energy coupling mechanism 82 of the dispenser. The coupling may be direct electrical, electromagnetic, optical or any known system providing power to the nozzle or recharging circuitry. Notably, one embodiment of the invention does not require an energy coupling and operates on a replaceable battery (e.g. 91 of Figure 5), while another embodiment is configured to operate on energy  
20 received and stored from an interrogation pulse from the dispenser's communications electronics 50.

The nozzle control and communications system 46 may also include an I/O port 106

communicating with the various nozzle components represented in Figures 4A, 5 and 6. The nozzle control system may receive volumetric flow data from a flow meter 108 or control delivery rates with a continuously variable electronic flow control valve 110. Control may be based on information received from the dispenser, predetermined  
5 algorithms stored in memory 94 or according to an output of a trigger position detector 116 based on the position of trigger 126. The output of the trigger position detector 116 may be used to control the nozzle's control valve 110 or be transmitted to the dispenser through the communications electronics 92 in order to control the fuel delivery system at the dispenser. Similarly, any flow related information from the flow meter 108, or  
10 other like devices, may be transmitted to the dispenser to control the dispenser's delivery and/or vapour recovery system.

The nozzle may also be configured with an octane sensor 112 located in the nozzle's fuel delivery path 132 in order to provide octane information to the nozzle controller 93 or  
15 transmit the information to the fuel dispenser, so the fuel dispenser can take appropriate action. Similarly, a hydrocarbon sensor 114 may be placed in the vapour return path 130 of the nozzle 14 to provide hydrocarbon concentration information for vapour recovery control. Typically, this information will be transmitted to the fuel dispenser to facilitate appropriate control of the vapour recovery pump 34, although the information may be  
20 used at the nozzle in certain embodiments. For additional information relating to transponder communications, attention is drawn to U.S. Patent 5,782,275 entitled ONBOARD VAPOUR RECOVERY DETECTION and WO 97/21626 entitled INTELLIGENT FUELLING. The control system may also drive a display 118 and

receive customer input from a keypad 120 and/or a card reader 122 in order to provide a user interface at the nozzle. It should be noted that the broadest concept of the invention does not require implementation of a customer interface at the fuel dispenser nozzle.

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The card reader 122 will typically include a slot 124 in the nozzle's body to facilitate swiping a card having a magnetic strip with information thereon. Many aspects of the present invention will use the wireless, radio communication interface for various types of communications to and/or from an associated fuel dispenser.

10

In the preferred embodiment the dispenser's communication and control system 42 is adapted to provide uni-directional or bi-directional communications between an intelligent transponder making up the nozzle's communications electronics 92 and the dispenser. The transponder may be integrated into the nozzle's control and communications electronics, or may be separate, yet associated with the nozzle's control electronics as shown in Figure 4B. For example, the communications electronics 92 may include a power supply 90A, a controller 93A, memory 94A, software 96A and the necessary transmitter and receiver 100, 98. The communications electronics 92 may include a clock 95 to synchronize communications between I/O port 106A of the communications electronics 92 and I/O port 106B of control electronics 93. The control electronics 93 of the embodiment of Figure 4B may also contain a controller 93A, memory 94B, software 96B and possibly a power supply 90B.

The embodiment of Figure 4B may be similar to the transponder incorporating the Micron Microstamp™ produced by Micron Communications, Inc., 8000 South Federal Way, Boise, Idaho 83707-0006. The Micron Microstamp™ engine is an integrated system implementing a communications platform referred to as the Microstamp™  
5 standard on a single CMOS integrated circuit.

A detailed description of the Microstamp™ engine and the method of communication are provided in its data sheets in the Micron Microstamp™ Standard Programmer's Reference Manual provided by Micron Communications, Inc. These references and the information  
10 provided by Micron Communications on their web site at <http://www.mncc.micron.com> are incorporated herein by reference. If the Micron Microstamp™ engine is used, the control electronics 93 shown in Figure 4B may also interface with additional control electronics configured to control the various nozzle devices, or such control may be provided by the control capabilities provided by the Micron Microstamp™. Regardless  
15 of the embodiment, communication and control functions may be separate or integrated, in addition to being provided on a single CMOS integrated circuit.

In the preferred embodiment, communications between the serial ports 106A and 106B are serial and synchronized using clock 95. The memory in any of the configurations  
20 may be random access memory (RAM) and/or read only memory (ROM), or a combination thereof. Preferably, the communications electronics incorporate a spread-spectrum processor associated with an 8-bit microcontroller. The nozzle transponder is preferably configured to receive direct sequence, spread-spectrum signals having a centre

frequency of 2.44175 GHz and adapted to transmit a differential phase shift key (DPSK) modulated back-scatter at 2.44175 GHz with a 596 KHz sub-carrier to the dispenser.

For the sake of conciseness and readability, the term "transponder" will be used herein  
5 to describe any type of remote communications unit adapted to receive energy and, in response thereto, transmit a signal. The transponder may be used to provide either uni-directional or bi-directional communications with the fuel dispenser.

The dispenser's communications electronics, preferably an interrogator, are adapted to  
10 cooperate in a communicative manner. For additional information on transponder/interrogator systems providing for highly secured transactions between a transponder and a host authorization system through a dispenser, attention is drawn to WO 99/04374 entitled CRYPTOGRAPHY SECURITY FOR REMOTE DISPENSER TRANSACTIONS; WO 99/04374 entitled MEMORY AND PASSWORD  
15 ORGANIZATION FOR REMOTE DISPENSER TRANSACTIONS; and WO 99/04374 entitled PROTOCOL FOR REMOTE DISPENSER TRANSACTIONS.

Now turning to Figures 7 and 8, two methods of providing radio communications between the fuel dispenser and nozzle are shown. In Figure 7, free air communications  
20 between the nozzle control and communication system 46 and the dispenser control and communication system 42 are provided. The signal is transmitted through free air, between the nozzle 14 and the dispenser 10. Preferably, the antennas associated with the respective communications systems are properly placed and/or duplicated to minimize the

potential for interference with the transmitted signals.

In Figure 8, radio communications between the dispenser 10 and nozzle 14 are provided using the fuel delivery hose 16 as a wave guide, wherein an internal wave antenna 128  
5 is placed in the fuel delivery path 132 or vapour recovery path 130 of the nozzle, or within the delivery path 20 or vapour return path 24 in the fuel delivery hose 16 proximate to the nozzle 14. Notably, the typical recovery hose 16 is configured to deliver fuel in the annular, outer portion of the delivery hose while the dispenser nozzle delivers the fuel through the central cylindrical path 132. The nozzle incorporates the  
10 requisite hardware to provide such cross communication between the nozzle and delivery hose 16 with respect to both the fuel delivery and vapour recovery. In the latter wave-guide embodiment, the delivery hose 16 is preferably made of a steel mesh or other similar material providing wave guidance between an internal wave antenna 128 associated with transmitter and receiver 100, 98 at the nozzle 14 and antenna, transmitter  
15 and receiver 78, 80 of the fuel dispenser 10.

Figure 9 depicts a basic process outlining communications between the intelligent nozzle and dispenser. In operation, the process begins (block D100) when the dispenser gathers information from any of the numerous dispenser components (block D102). The  
20 information is processed at the dispenser (block D104) and transmitted to the nozzle (block D106). The nozzle receives the information transmitted from the dispenser (block N100) and gathers information from the various nozzle components, if necessary, (block N102). The nozzle processes any information received from the transmitter or the nozzle

components (block N104) and controls any of the various nozzle components as necessary (block N106). The nozzle may transmit certain information back to the dispenser (block N108). The dispenser receives the information transmitted from the nozzle (block D108), processes the information (block D110), and controls any dispenser components  
5 as necessary (block D112). At this point, the process will repeat, wherein the dispenser will gather information from the dispenser components (block D102), process information (block D104), and transmit the information to the nozzle (block D106).

Preferably, during operation the communication system of the dispenser will remain in  
10 secure and verifiable contact with the nozzle's communications and control system. In classic interrogation embodiments, the dispenser interrogator may interrogate the nozzle at a rate of twenty (20) contacts per second, for example, to provide such secure contact and rapid communication of information back and forth between the dispenser and nozzle, as necessary.

15

This system provides numerous benefits to the fuelling operation. For example, readings from any of the dispenser components may be directly or indirectly transmitted to the nozzle for processing or display to the customer at the nozzle's display 118. In like fashion, any of the data read at the nozzle by any of the nozzle components, may be  
20 transmitted to the dispenser for processing and/or display at one of the dispenser's displays.

The information from either the nozzle or the dispenser may aid fuel delivery or vapour

recovery control. For instance, readings from the nozzle trigger 126 and the trigger position detector 116 may be used to control fuel flow electronically at the fuel dispenser, by controlling the fuel delivery pump 36 and/or the control valve 40. The converse is equally capable. Additionally, metering data, octane ratings and hydrocarbon concentrations may be read at the nozzle and provided to the fuel dispenser for use. In short, any information obtainable at the dispenser may be provided to the nozzle, and vice versa, during a fuelling operation to control nozzle components and affect the display of information to a customer. Any information obtained at or by the nozzle may be transmitted to the fuel dispenser for control or display purposes during a fuelling operation. Such data transfer has previously been unavailable without complex, expensive and basically unacceptable direct electronic communication means.

The communications electronics at the nozzle may be configured or include additional transmitters or receivers to communicate with a transponder or like remote communications unit held by a customer or mounted on a vehicle. The nozzle's control system would, in effect, relay information received from the vehicle-mounted transponder to the dispenser through the nozzle's control and communications system 46.

Certain modifications and improvements will occur to those skilled in the art upon reading the foregoing description. It should be understood that all such modifications and improvements have been deleted herein for the sake of conciseness and readability, but are properly within the scope of the following claims.

**CLAIMS**

1. A nozzle (14) for a fuel dispensing system (10) characterised in comprising a control system (93) and wireless communication electronics (92) operatively associated with said control system and adapted to provide wireless communications between said nozzle and a dispensing system communication device (42).
2. A nozzle as claimed in claim 1 further comprising a power supply (90, 91) for said control system.
3. A nozzle as claimed in claim 2, wherein said power supply (90) is adapted to receive electromagnetically coupled energy.
4. A nozzle as claimed in claim 2, wherein said power supply (90) is adapted to receive optically coupled energy through an optical-to-electrical converter.
5. A nozzle as claimed in claim 2, 3 or 4 wherein said power supply includes a battery (91).
6. A nozzle as claimed in any preceding claim, further comprising a display (118) coupled to said control system (93) to display information output from said control system.

7. A nozzle as claimed in any preceding claim, further comprising an input device (120; 122) coupled to said control system (93) to input information to said control system for transmission to the fuel dispensing system (10) via said communication electronics (92).
8. A nozzle as claimed in claim 7, wherein the input device is a card reader (122).
9. A nozzle as claimed in any preceding claim, further comprising a trigger (126) operatively coupled to a position detector (116) adapted to provide a trigger position signal indicative of trigger position, said control system (93) being adapted to receive the trigger position signal and provide a flow control signal based thereon.
10. A nozzle as claimed in claim 9, further comprising a flow control valve (110) responsive to said flow control signal to control fuel flow based on trigger position.
11. A nozzle as claimed in claim 9 wherein said flow control signal is transmitted via said communication electronics to the fuel dispensing system (10) to control fuel flow.
12. A nozzle as claimed in any preceding claim further comprising a flow meter (108) providing fuel flow information to said control system (93) for transmission to the fuel dispensing system (10) via said communication electronics (92).
13. A nozzle as claimed in any preceding claim further comprising an octane sensor

(112) providing an octane rating information to said control system (93) for transmission to the fuel dispensing system via said communication electronics (92).

14. A nozzle as claimed in any preceding claim further comprising a hydrocarbon sensor (114) providing a hydrocarbon concentration information to said control system (93) for transmission to the fuel dispensing system via said communication electronics (92).

15. A nozzle as claimed in any preceding claim wherein said communication electronics includes a transponder adapted to receive energy from the dispensing system communication device and, in response thereto, transmit a signal to the dispensing system communication device.

16. A nozzle as claimed in any one of claims 1 to 15 for a fuel dispenser.

17. A nozzle as claimed in claim 16 wherein the fuel dispensing system is a fuel dispenser.

18. A nozzle as claimed in claim 16 or 17, further comprising additional communication electronics coupled to said control system and adapted to communicate with a remote communications unit apart from said nozzle and the dispenser.

19. A nozzle as claimed in claim 16, 17 or 18 wherein said communication electronics

includes a receiver (98) arranged to receive a signal transmitted within a delivery hose (16) communicating with the nozzle and a fuel dispenser (10).

20. A fuel dispensing system comprising communication electronics (50) and a control system (48) adapted to wirelessly communicate with a nozzle (14), in accordance with any preceding claim, through said communication electronics.

21. A fuel dispensing system as claimed in claim 20 wherein said control system (48) is adapted to generate nozzle control information and transmit said nozzle control information to the nozzle via said communication electronics (50).

22. A fuel dispensing system as claimed in claim 20 or 21 wherein said control system is adapted to receive flow control information from the nozzle (14) via said communication electronics (50) and control delivery of fuel system accordingly.

23. A fuel dispensing system as claimed in claim 22 further comprising means (40) for controlling the flow rate in dependence on the trigger position at the nozzle as determined by the control system.

24. A fuel dispensing system as claimed in any one of claims 20 to 23 wherein said control system (48) is adapted to receive customer input information from the nozzle via said communication electronics (50) and control said dispensing system accordingly, wherein the customer input information is entered at an input device (120; 122) at the

nozzle.

25. A fuel dispensing system as claimed in any one of claims 20 to 24 further comprising a vapour recovery system (34) associated with said control system (48) wherein said control system is adapted to receive a sensor signal indicative of a hydrocarbon concentration in a vapour return line in the nozzle and said control system is adapted to control said vapour recovery system according to the sensor signal.

26. A fuel dispenser comprising a fuel dispensing system as claimed in any one of claims 20 to 25.

27. A fuel dispenser as claimed in claim 26 wherein the fuel dispensing system is a fuel dispenser.

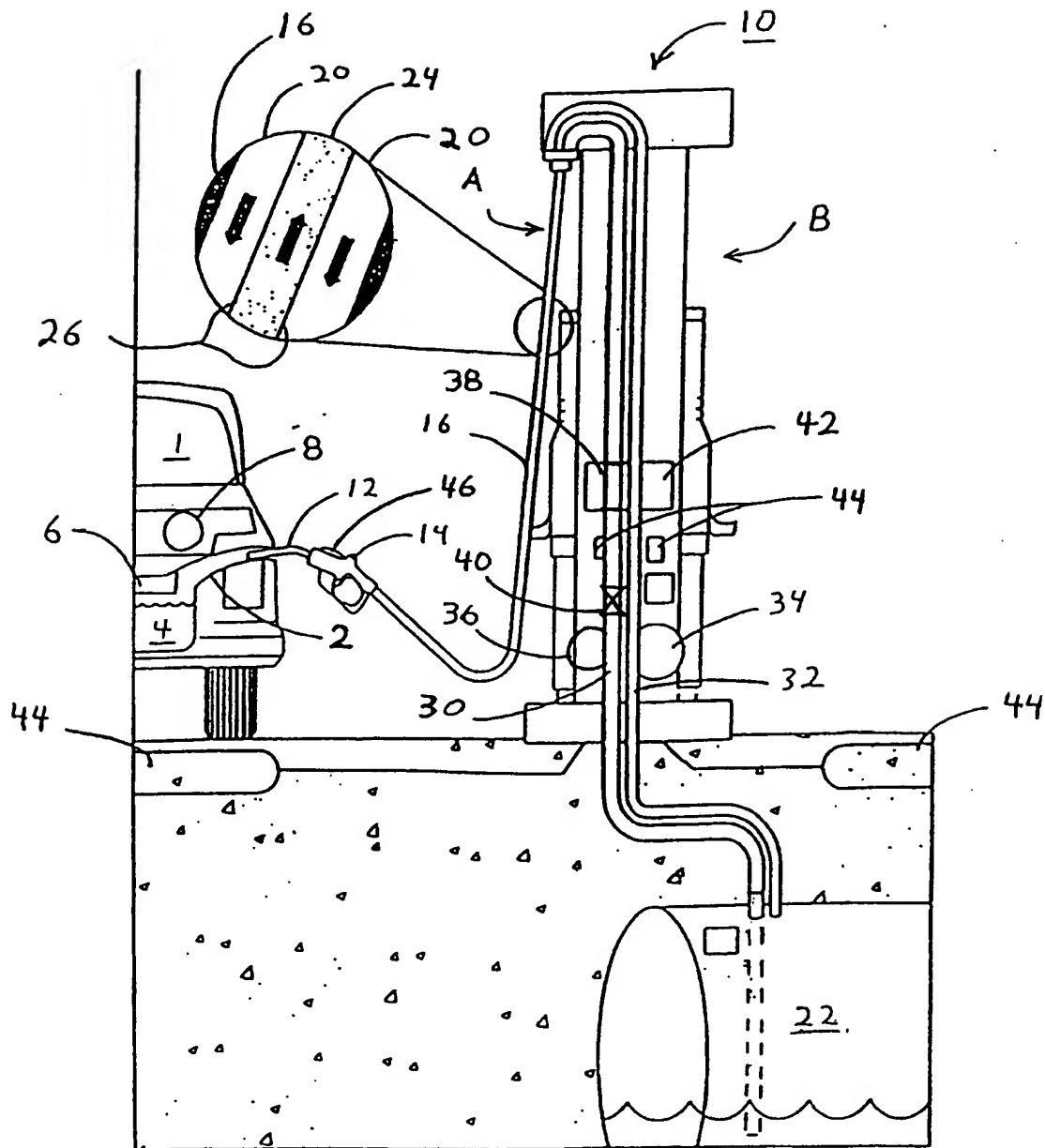
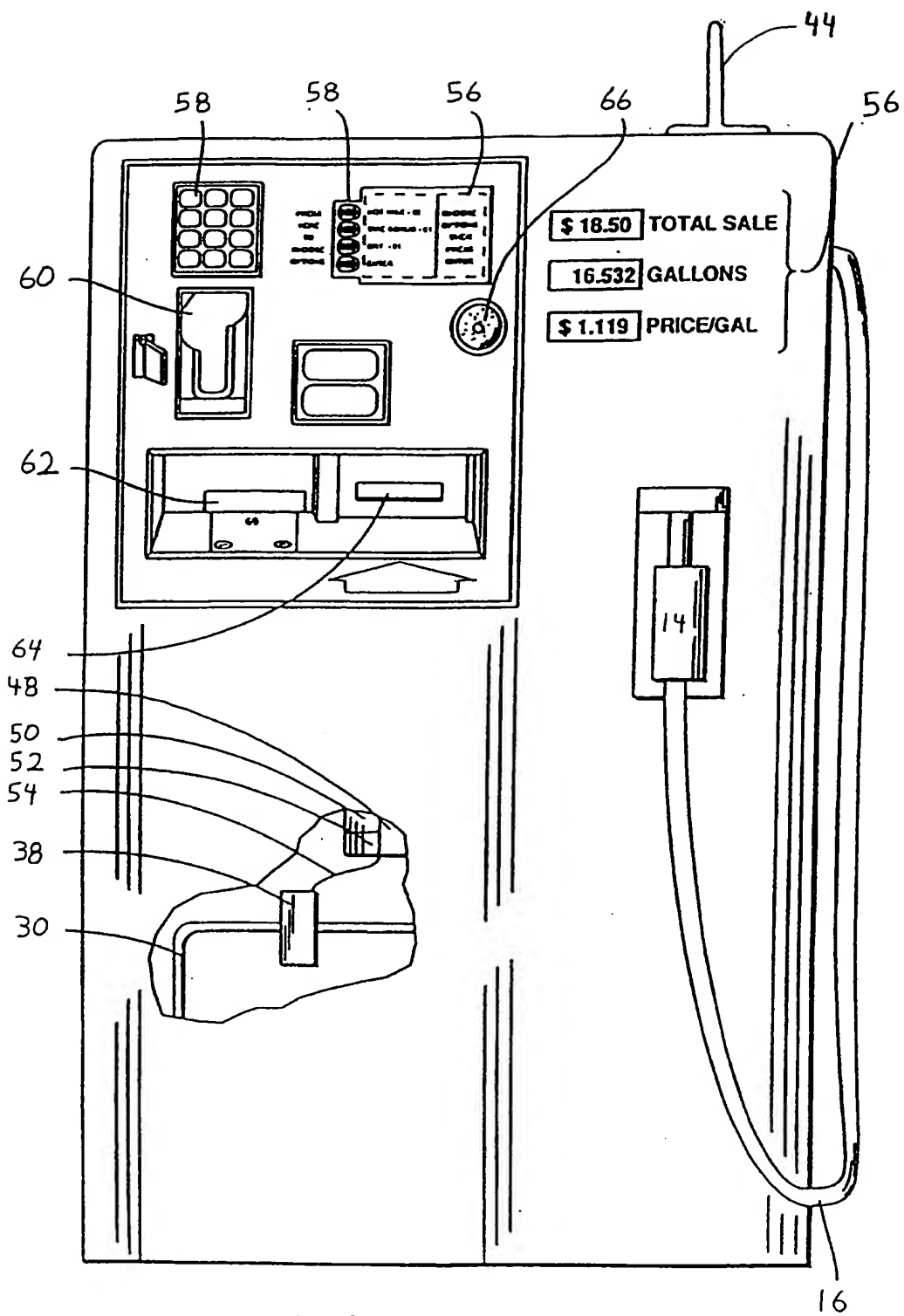


FIG. 1



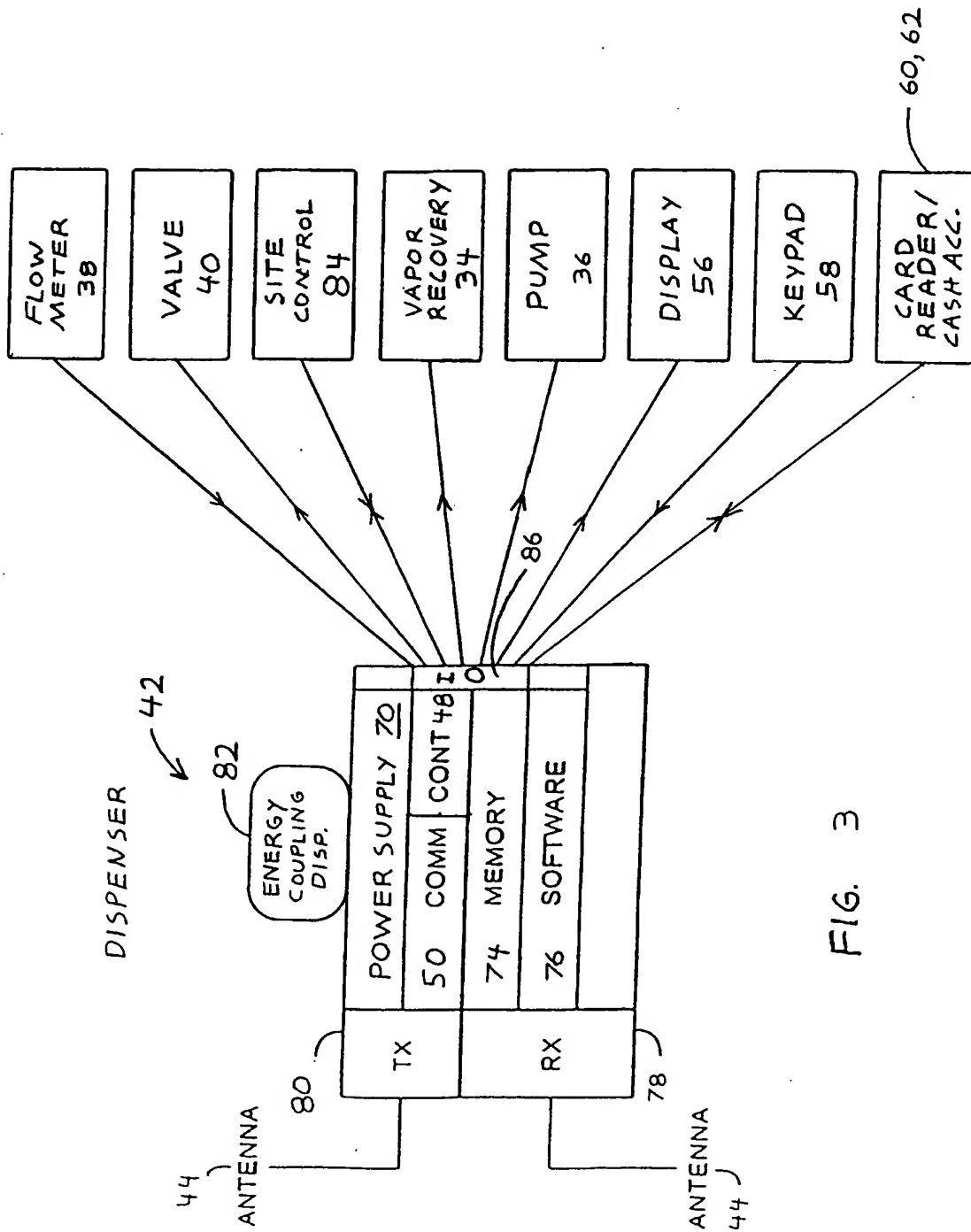


FIG. 3

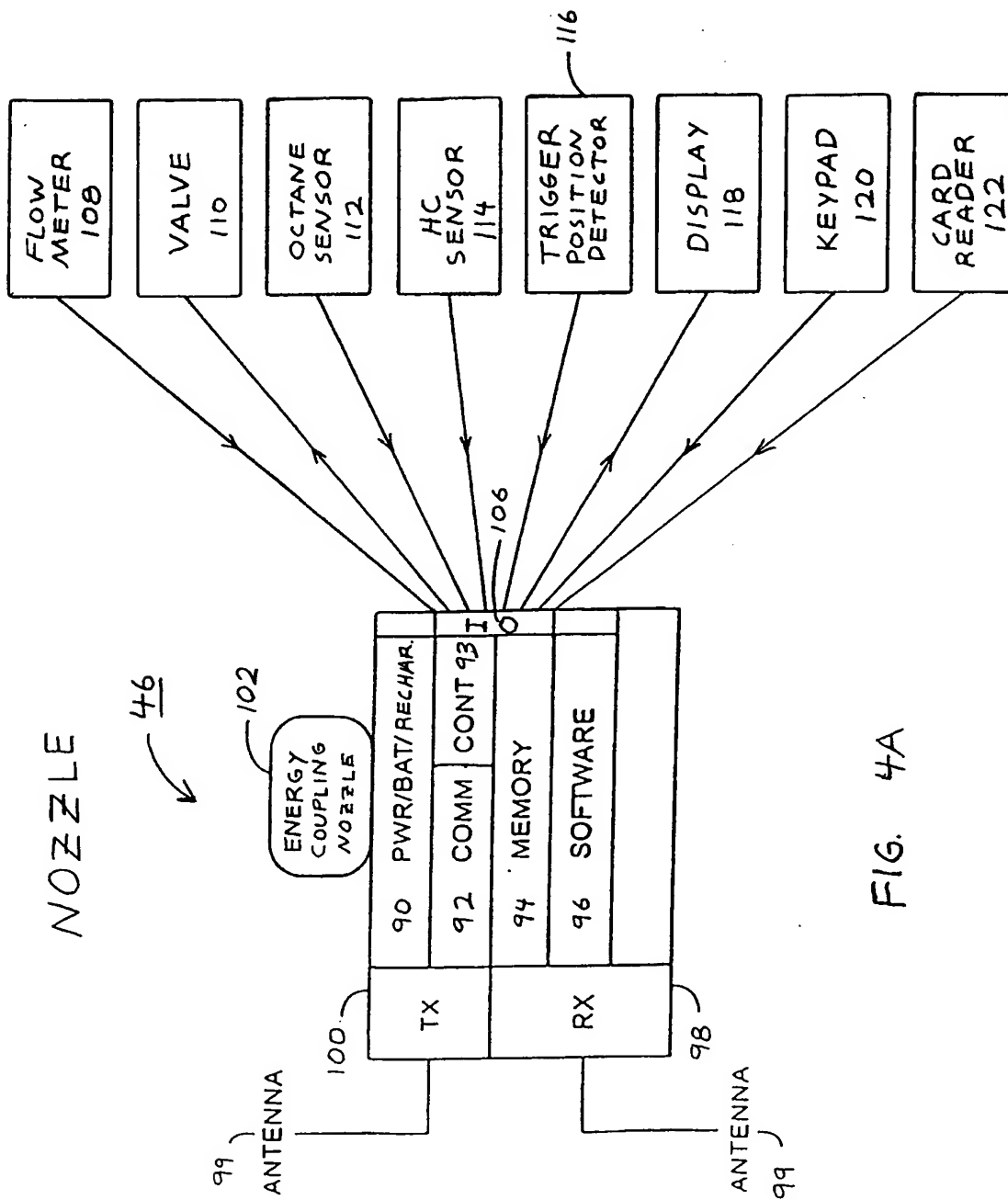


FIG. 4A

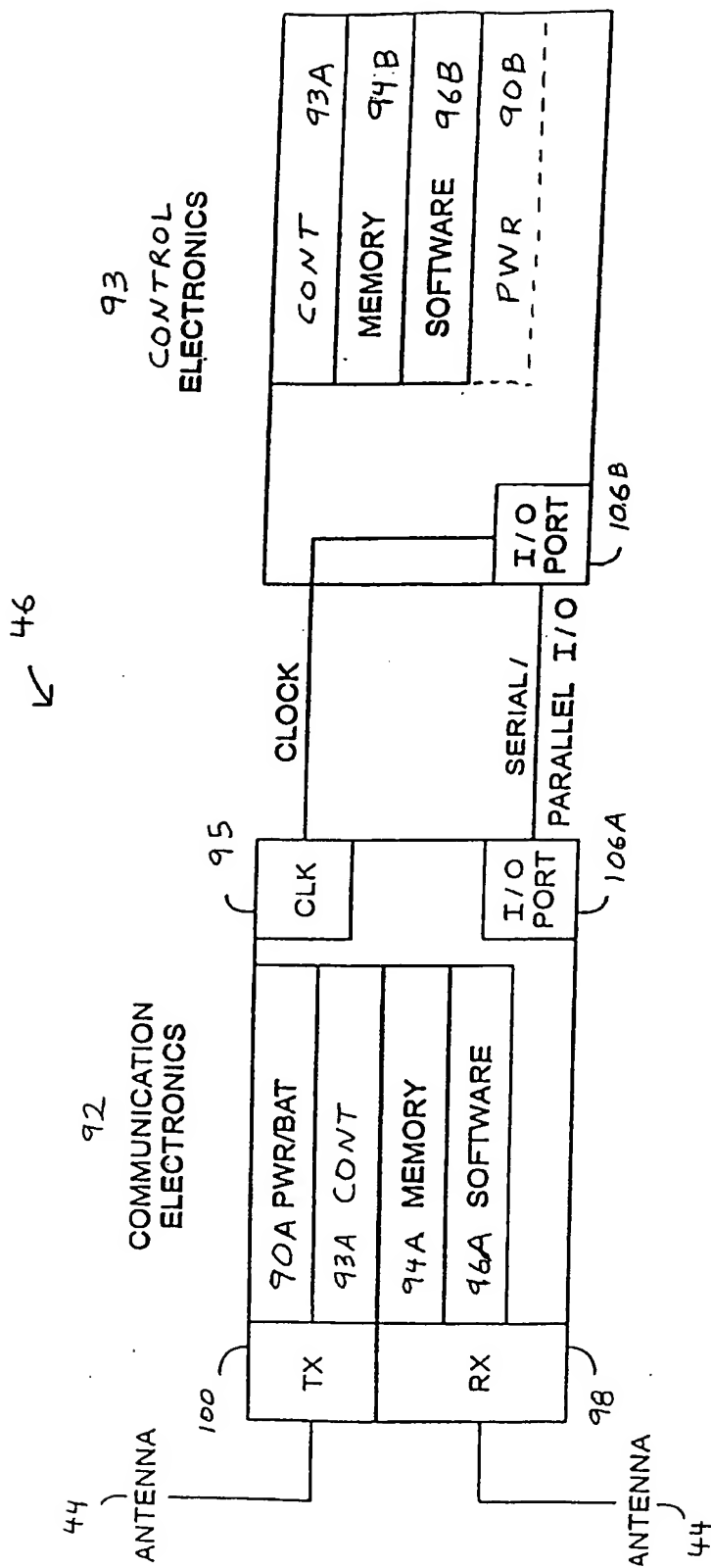


FIG. 4B

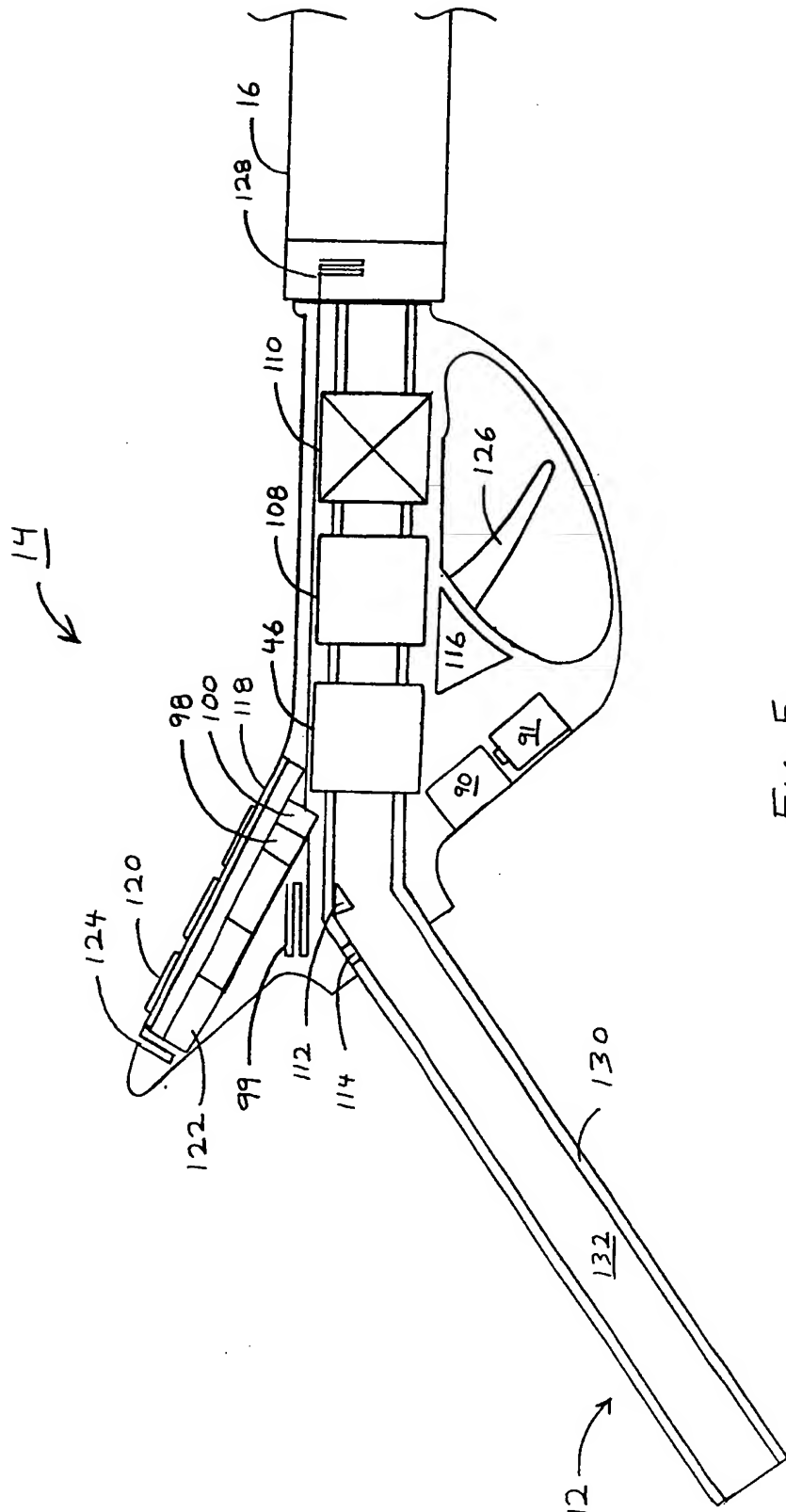
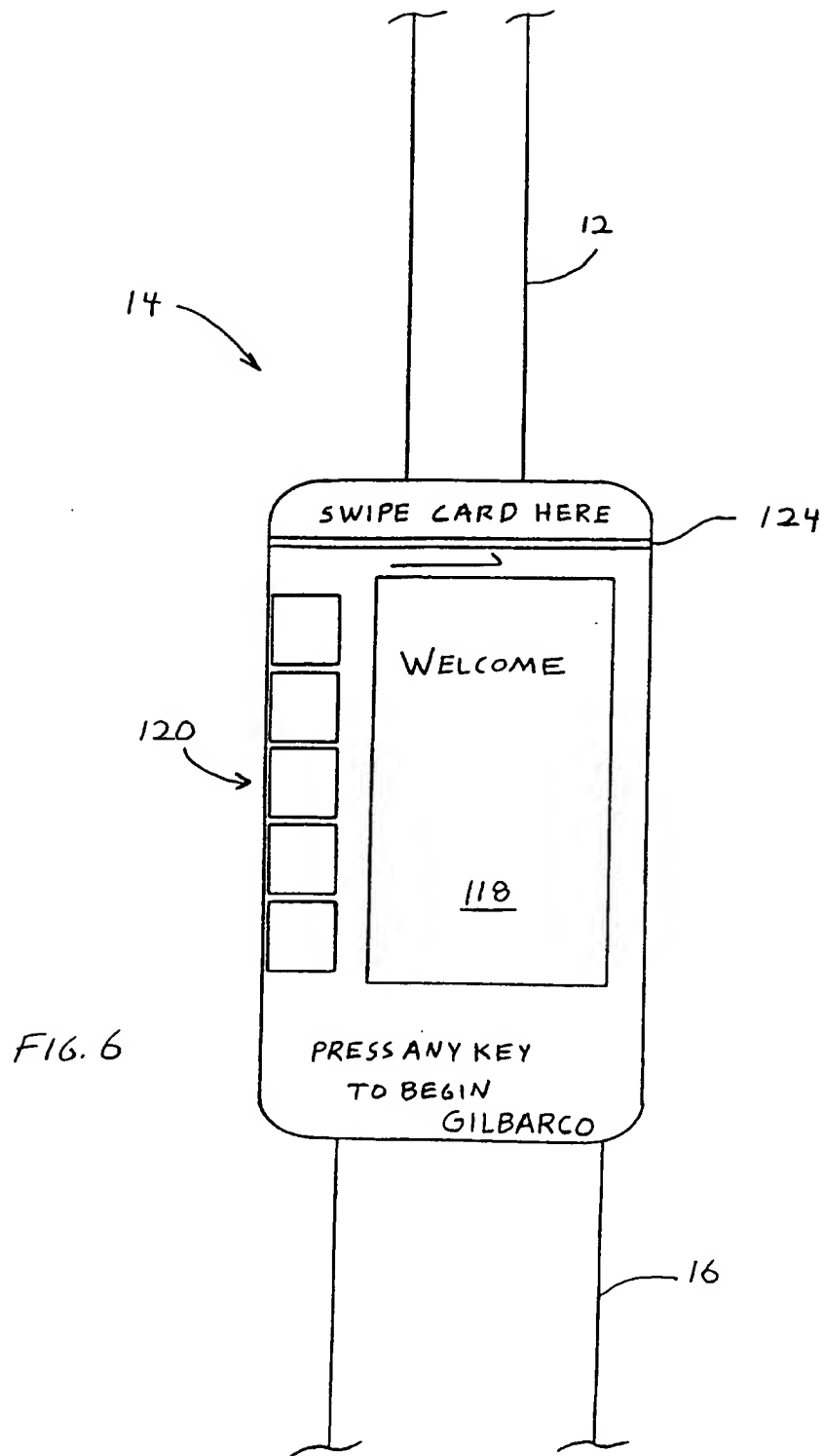


FIG. 5



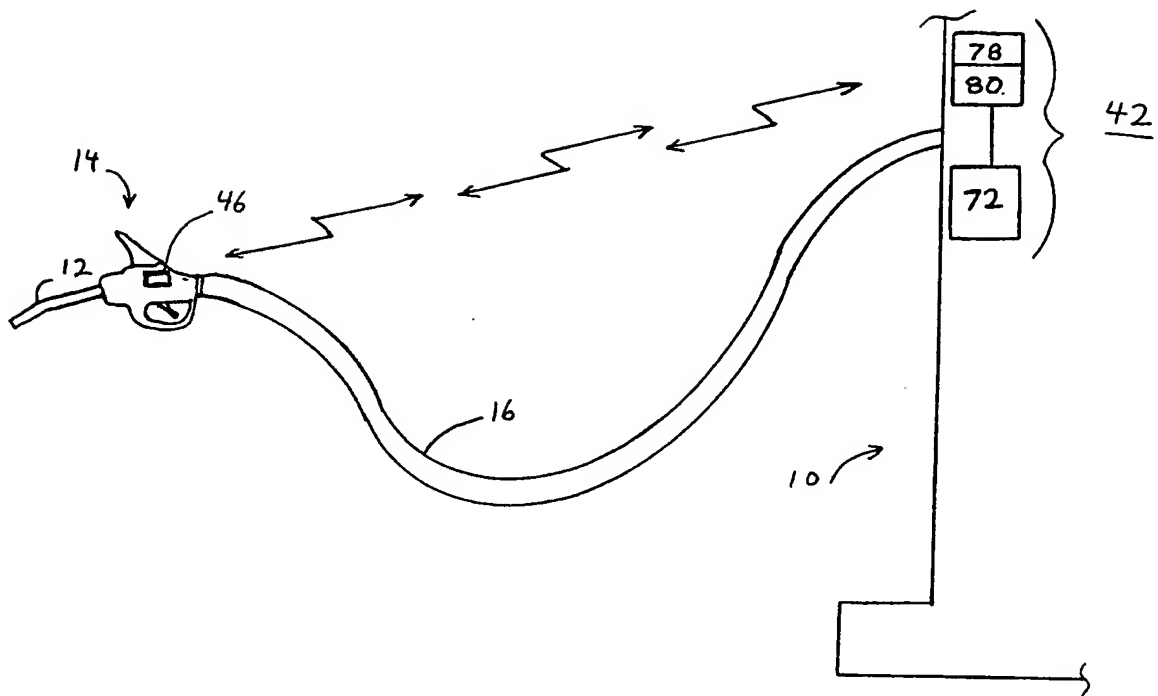
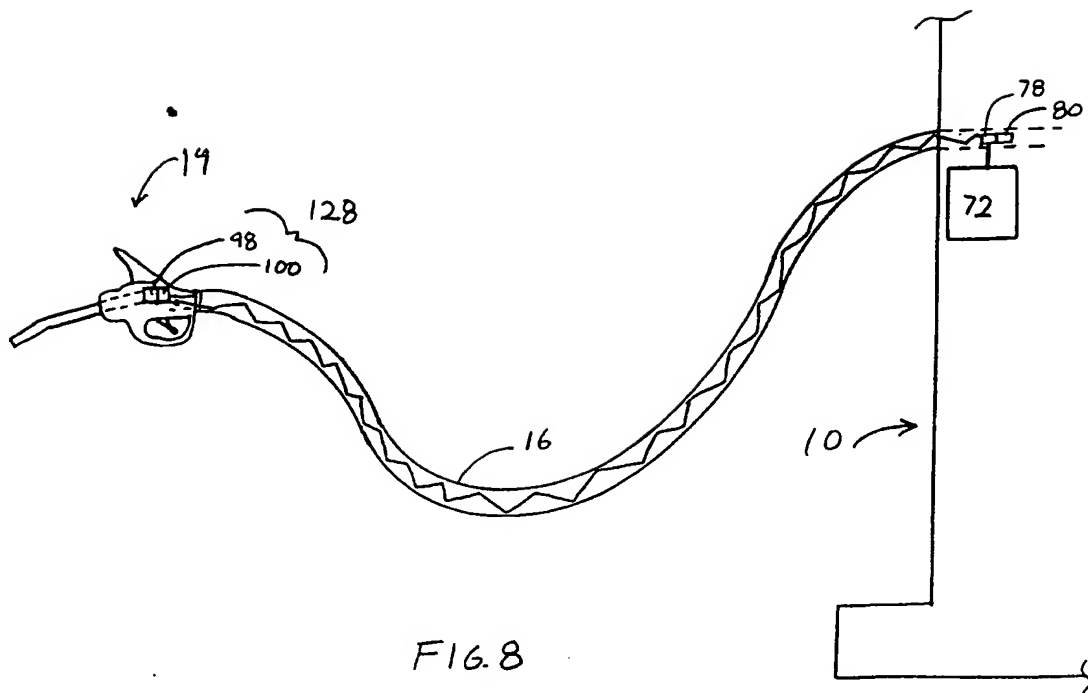
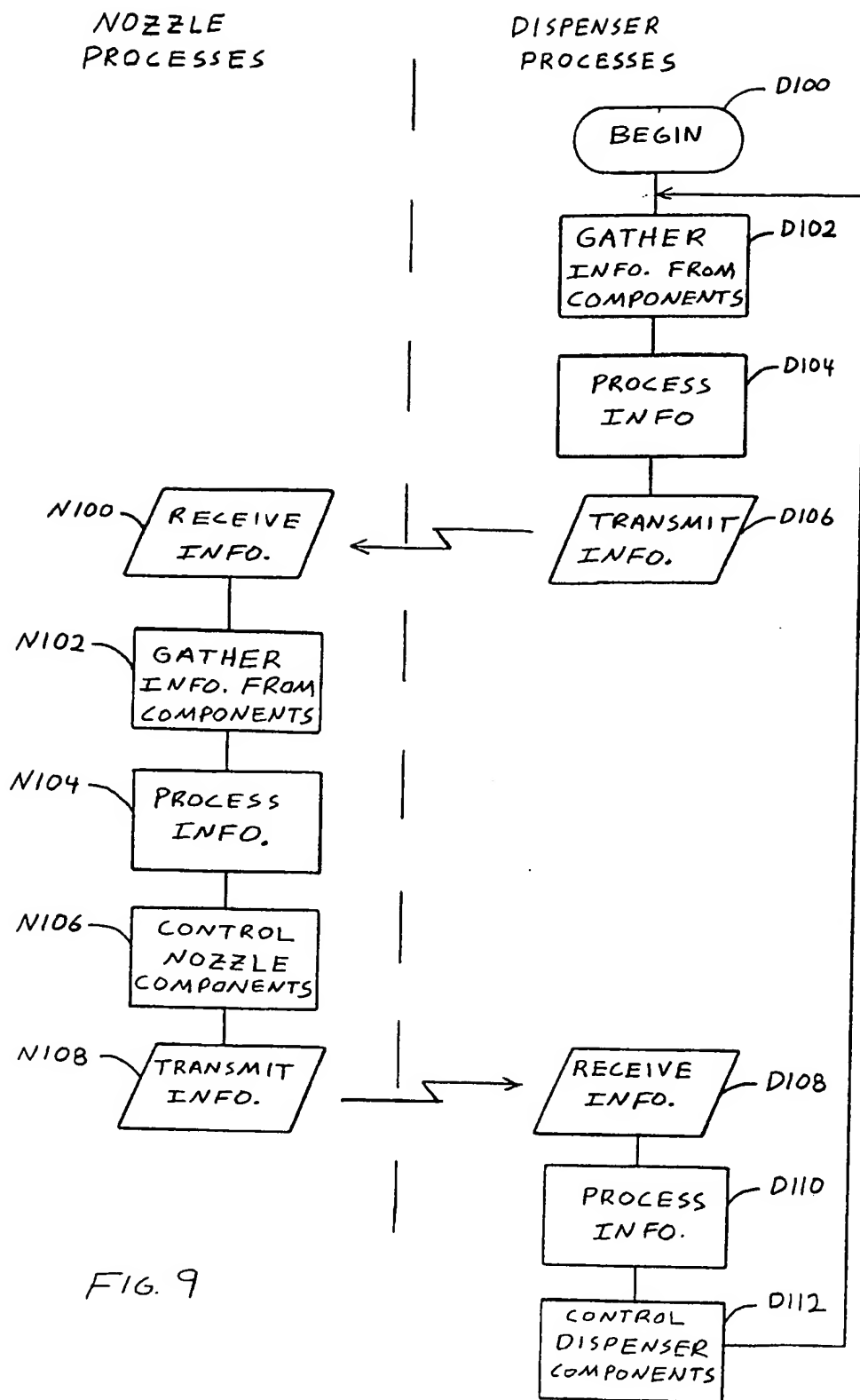


FIG. 7





# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 99/00661

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 B67D5/14

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 B67D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 736 484 A (RYAN MICHAEL C) 9 October 1996	1-3, 5-8, 12, 15-18, 20-22, 24, 26, 27 4, 13, 14
Y	see column 1, line 34 - line 40 see column 2, line 8 - line 20 see column 4, line 31 - line 34 see column 4, line 49 - line 54 see column 8, line 3 - line 5 see column 9, line 10 see column 10, line 14 - line 42 see column 11, line 4 - line 6 see column 11, line 28 - line 35 see column 12, line 29 - line 37 see column 13, line 1 see column 13, line 25 - line 26 see column 13, line 46 - line 48 see column 13, line 55 - line 58 -/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

31 May 1999

Date of mailing of the international search report

08/06/1999

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Authorized officer

Martínez Navarro, A.

# INTERNATIONAL SEARCH REPORT

Inte. onal Application No

PCT/GB 99/00661

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	<p>see column 14, line 10 - line 38</p> <p>see column 20, line 54 - line 58</p> <p>see column 23, line 16 - line 30</p> <p>---</p>	
Y	<p>DE 34 38 939 C (DEUTSCHE GERÄTEBAU GMBH)</p> <p>22 May 1986</p> <p>see column 5, line 33 - line 53</p> <p>---</p>	4
Y	<p>EP 0 298 464 A (JUNKOSHA CO LTD)</p> <p>11 January 1989</p> <p>see column 3, line 1 - line 11</p> <p>---</p>	13
Y	<p>EP 0 653 376 A (DRESSER IND) 17 May 1995</p> <p>see abstract</p> <p>---</p>	14
A	<p>US 5 505 234 A (SIMPSON W DWAIN ET AL)</p> <p>9 April 1996</p> <p>see abstract</p> <p>---</p>	1,9
X	<p>WO 97 35284 A (SHELL INT RESEARCH)</p> <p>25 September 1997</p> <p>see page 5, line 25 - line 33</p> <p>see page 7, line 4 - line 5</p> <p>---</p>	1,20
A	<p>US 5 654 497 A (HOFFHEINS BARBARA S ET AL) 5 August 1997</p> <p>see claim 1</p> <p>-----</p>	1,13

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Information on patent family members

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PCT/GB 99/00661

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